UNITED STATES

Aeronautics & Space Activities

1968

THE EARTH FROM ATS-III 22,300 MILES IN SPACE

EXECUTIVE OFFICE OF THE PRESIDENT

NATIONAL AERONAUTICS AND SPACE COUNCIL

WASHINGTON, D. C. 20502

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DEPARTMENT OF DEFENSE

CHAPTER IV

Introduction

Three major actions and events highlighted Department of Defense space and aeronautical activity during 1968: (1) Enlargement of the Phase I Defense Satellite Communications System to a constellation of 22 operating satellites and 39 surface terminals; (2) Growth of the TRANSIT navigational satellite system to a four-satellite, fully operational system; and (3) First flights of the C–5A, the world's largest military cargo aircraft.

Space Development Activities

Manned Orbiting Laboratory—Development of the Manned Orbiting Laboratory (MOL) continued to progress during the year with the program approaching its peak of activity.

The flow of structural test assemblies of major system components between associate contractors began, and procurement of various subsystem components continued. Demonstration firings of the first-stage engine of the TITAN IIIM booster engine were concluded successfully, and preparations were made for static test firings of the booster's second-stage liquid-fuel engine and the seven-segment solid rocket motors. Construction of the MOL launch complex at Vandenberg Air Force Base, California, neared completion and preparations were made for the installation of associated ground equipment.

Fourteen Aerospace Research Pilots continued training for the 30-day MOL missions, during which they will conduct defense-oriented experiments involving very complex equipment. The flight program will advance both manned and unmanned space technology and ascertain the full extent of man's utility in space for defense purposes.

The close working relationship between NASA and DOD continued to provide an exchange of technology, hardware and experience valuable to both the APOLLO and the MOL programs.

Titan III Space Booster—The TITAN III Program continued in the flight test phase, with two TITAN IIIC launches occurring during the year. The first launch, in June, successfully carried eight initial Defense Communications Satellites into orbit; the second, in September, placed three Office of Aerospace Research satellites and one experimental communication satellite into various orbits.

The R&D flight test program has been extremely successful. A total of 58 useful payloads have been carried on nine of the TITAN IIIC developmental launch vehicles to date.

The R&D goals of the TITAN IIIC development program have been essentially accomplished, although two R&D vehicles remain to be flown. TITAN III configurations are being produced both with and without the large solid motors attached, thus making it possible to handle a wide variety of military payloads. The TITAN III configurations have demonstrated high reliability, and there is a great degree of commonality between versions.

DOD Satellite Communications—The DOD program for satellite communications consists of the Long Distance Point-to-Point System and the Tactical Satellite Communications Program.

Long Distance Point-to-Point System—This system meets the Government's unique needs for satellite communications. It consists of the SYNCOM, Defense Satellite Communications System (DSCS), and International Cooperative Efforts.

SYNCOM—The SYNCOM satellites, developed and orbited by NASA originally for R&D purposes, have provided DOD Earth terminals with an interim means for passing operational traffic in the Pacific area. Dur-

ing 1968, as the greater capabilities of the DSCS became increasingly available, use of the SYNCOM satellites by DOD decreased. SYNCOM II is no longer scheduled for use because of technical difficulties; however, SYNCOM III is in regular use. Shipborne terminals have been activated aboard the USS ANAPOLIS and USS ARLINGTON and use SYNCOM III to operate with a ground terminal at Guam to provide an operational system for the Navy.

Defense Satellite Communications System (DSCS)—The Initial Defense Communications Satellite Project (IDCSP) was declared operational in 1967, and since that time has been designated Phase I of the Defense Satellite Communications System. The Phase I space subsystem deployment was completed in June 1968, when eight additional satellites were successfully orbited by a TITAN IIIC launch vehicle. Of the total of 26 Phase I satellites placed in orbit, 22 are currently being scheduled for operational use. The initial ground terminal procurement of 29 terminals has also been completed, with terminals deployed to New Jersey, Maryland, Colorado, California and Alaska, as well as Hawaii, Guam and other overseas bases. Additionally, three terminals have been leased from industry and deployed overseas. Seven shipborne terminals are being modernized for installation on Fleet flagships and the USS WRIGHT.

This Phase I system has proved a most useful addition to command and control communications capability. It has permitted the re-routing and continuation of vital communications during two separate cable breaks in the Western Pacific, and it has provided a new capability not previously possible—the rapid transmission of high-quality photographs directly from Vietnam to the United States.

In June 1968, it was decided to proceed with Phase II of the DSCS. Under current Phase II concepts, several new satellites will be placed in synchronous equatorial orbit by early 1971. They are to be equipped with "Earth coverage" antennas which direct most of their radiated power towards the Earth so as to uniformly cover that portion of the globe visible to the satellite. In addition, there will be steerable narrow-beam antennas capable of concentrating a portion of the satellite's power on an area of the Earth's surface one to two thousand miles in diameter.

Each new satellite will be able to provide hundreds of voice channels over the portion of the Earth visible to it and additional hundreds of channels within the narrow beam areas. The Phase II Earth subsystem will utilize to the maximum the terminals acquired during Phase I by modifying them to Phase II specifications. Additional terminals will be procured and certain new types of terminals will be developed to meet special requirements. With the new satellites and increased number of Earth terminals, the Phase II system will greatly increase the number of satellite channels available for unique Government needs. It will provide greater communication capabilities into and within theaters of operations much more quickly and effectively than do conventional communications techniques.

International Cooperative Efforts—Under the provision of an earlier Memorandum of Understanding, the Department is procuring two synchronous "SKYNET" satellites for the United Kingdom as an augmentation of the United States Phase I system. The first SKYNET satellite is scheduled for launch in mid-1969. Tests using Phase I satellites were conducted in which simultaneous operation of two United States and two United Kingdom Earth terminals demonstrated the feasibility of simultaneous but independent use of one satellite. In addition, there were exploratory talks with the United Kingdom of possible operational use of the Phase II system by that nation.

Cooperative effort with NATO for the establishment of NATO's preliminary satellite communications system continued during 1968. Use of Phase I satellites was provided to NATO for tests between two Earth terminals purchased from a U.S. firm by NATO. Also during 1968, procurement actions by NATO resulted in the Department contracting with a U.S. commercial source for a SKYNET-type satellite for NATO use beginning in late 1969.

Support of Canadian R&D satellite communications tests continued with the preparation of plans for additional tests in early 1969.

Tactical Satellite Communications Program (TACSATCOM)—This is a joint Service Program which has made substantial progress during the past year. Building on the earlier work of the Massachusetts Institute of Technology Lincoln Laboratory experimental satellite series, the Services in 1968 continued test-

ing of the fifth satellite (LES-5), launched in July 1967 into a near-synchronous equatorial orbit with a slow eastward drift. New communications techniques have been tested, using experimental terminals installed in airplanes, ships and trucks; and joint tests were conducted with selected NATO countries. Aircraft, ships and ground terminals have acquired valuable data through the exchange of error-free teletype messages, without interruption, over transoceanic and transcontinental distances. A larger and more advanced satellite (LES-6) was successfully orbited on September 26, 1968. This satellite is now in stationary synchronous orbit, and the Services have initiated an extensive test program to explore further the uses and techniques for tactical communications.

A larger, more complex satellite (TACSAT I) is now scheduled for launch in early 1969. This satellite will be tested, in conjunction with a limited number of communications terminals installed in tactical vehicles, operational aircraft and combat ships, to provide the basis for the development of a truly operational tactical satellite communication system within the next few years.

The Air Force has had the responsibility for developing and launching the experimental satellites for the TACSATCOM Program and has developed appropriate aircraft terminals. Extensive testing of these terminals has proceeded, in coordination with the other Services.

The Army has built and is testing several types of ground terminals—jeep, shelter and van installations—under varied environmental conditions and in simulated tactical situations to demonstrate the operational feasibility of using spacecraft repeaters for tactical communications needs. An advanced portion of the Army program involves two families of terminal configurations, similar except for frequency bands. These terminals are being developed on a concept of modular construction and commonality of basic equipments to guarantee interoperability betwen terminal types. The terminals have been developed in man-pack, team-pack, jeep-mounted, shelter installations, airborne and seaborne configurations. Tests will be initiated in early 1969, with the launch of the TACSATCOM I satellite.

Using similar techniques, the Navy is extensively testing terminals aboard ship, on naval aircraft, with other Services and in supporting laboratories to demonstrate the feasibility of using satellites for reliable naval tactical communications and to develop operational procedures and doctrine. All practical operational applications are being explored with a view toward enhancing open-sea communications reliability.

The military Services are conducting a cooperative TACSATCOM testing program involving nine NATO participants—Belgium, Canada, Federal Republic of Germany, Italy, The Netherlands, Norway, SHAPE Technical Centre, United Kingdom and United States. The NATO countries joined with the United States in the test program, using terminals built in their own countries or purchased in the United States.

Spaceborne Nuclear Detection (VELA)—The purpose of the VELA Satellite Program is to develop a satellite capability to detect nuclear explosions from the Earth's surface to deep space. It is a joint research and development program of the Department of Defense and the Atomic Energy Commission.

Launches of two satellites each have occurred in 1963, 1964, 1965, and 1967; another launch is scheduled for 1969. The AEC-furnished payload for detecting nuclear radiation, electromagnetic pulse signals, optical radiation from the fireball, and natural space background will incorporate improvements to previous designs.

The on-orbit spacecraft have continued to perform well. In addition to the function of monitoring for nuclear test ban treaty violations, the spacecraft are supplying a wealth of natural radiation background data which are used by NASA, the Environmental Science Services Administration (ESSA), and DOD.

Geodetic Satellites—Effort in the DOD geodetic satellite program during 1968 included observations of GEOS-B, PAGEOS, NAVY NAVIGATION SATELLITES, SECOR, and other satellites. The GEOS-B, which carries a SECOR transponder, an optical beacon, a Doppler transmitter, and a range/range rate transponder in addition to laser reflectors and a C-Band beacons, was launched by NASA in January 1968. The geodetic satellites will continue to provide more precise information about the Earth's size, shape, mass, and gravitational field, in addition to determining geodetic positions for features on the Earth's surface.

The Army Corps of Engineers continued the SECOR Geodetic Satellite Program, providing a global control net around the equatorial area and geodetic positions for range tracking instrumentation. Observations made in 1968 resulted in the extension of the SECOR network to the Indian Ocean area. It is expected that the network will be completed when the last link, at Hawaii, is closed during 1969. A second major program managed by the Army, and accomplished by the Army and the Coast and Geodetic Survey, is the PAGEOS Primary Geometric Network. This program will establish a world-wide geometric net and constitutes the primary contribution to the National Geodetic Satellite Program. Observations have been accomplished from 33 of the 45 stations, and are scheduled to be completed by the end of Fiscal Year 1970.

The Navy Doppler Network (TRANET) observed several satellites during 1968, including the NAVY NAVIGATION (TRANSIT) SATELLITES, GEOS–A, and GEOS–B. Thirteen permanent stations and five mobile vans were in operation. These data are used to improve the model of the Earth's gravity field and provide center-of-mass positions for specific locations as required. The program has now resulted in the determination of harmonic coefficients of the gravity model through the 12th degree and order, and selected higher terms. (Prior to the use of satellites, the gravity model was known only through the second degree and order.) In addition, the positions of 19 new sites were determined this past year.

The Air Force PC–1000 camera systems continue to operate in South America to provide a satellite densification network in support of mapping and charting efforts in that area.

Navigation Satellite System (TRANSIT)—The TRANSIT System, operated by the United States Navy, achieved the operational four-satellite constellation in March, when a new commercially built satellite joined the three laboratory-built satellites launched in 1967. The TRANSIT System was officially declared fully operational to the Fleet in October.

Following the Vice President's announcement of the release of the TRANSIT System for commercial use in 1967, two companies have developed shipboard receivers for sale to interested U.S. parties.

Space Ground Support

DOD National Ranges—The principal Department of Defense National Ranges which provide ground (and airborne) support for space activities are: (1) Air Force Eastern Test Range (ETR), (2) Air Force Western Test Range (WTR), (3) Air Force Satellite Control Facility (SCF), (4) Navy Pacific Missile Range (PMR), and (5) Army White Sands Missile Range (WSMR). All provide range support to all Government users whose programs are uniquely suitable for implementation at a particular range or ranges. All are currently in the process of conversion of telemetry systems to operation in the Ultra High Frequency (UHF) band. At PMR and WSMR, space activity amounts to approximately 4% of the total range effort. Activity at the major space support ranges follows:

Eastern Test Range—During the past year the Eastern Test Range has been emphasizing development and improvement of its mobile data-gathering fleet. These are aircraft and ships which can be strategically located throughout the world to gather data for various ballistic and space programs when land-based instrumentation is not adequate or available.

Eight APOLLO Range Instrumented Aircraft became operational in 1968 and successfully supported various DOD programs and the manned APOLLO program. Four additional telemetry aircraft will become operational in 1969. A modification program to improve the support capability of the Advanced Range Instrumentation Ships has also been initiated.

Western Test Range—Five instrumented ships developed for the support of the APOLLO program became operational in the spring of 1968. These ships are operated by the Air Force in support of NASA.

A precision tracking radar, an FPQ–6, became operational at the Western Test Range's Pillar Pt., Calif., tracking site in June 1968. This radar will improve the capability for accurate flight trajectory measurements of ballistic missiles launched from Vandenberg Air Force Base, Calif.

Bikini Atoll, which was under the control of the Western Test Range, was recently returned to the Trust Territories of the Pacific. The AEC has declared that this location is now habitable.

Satellite Control Facility—Major effort has been continued toward overall upgrading of Satellite Control Facility capabilities established in previous years. Construction began on a new addition to the Satellite Test Center at Sunnyvale, Calif. This will provide 14 new Mission Control complexes and house the Advanced Data System (ADS) and the Expanded Communications Electronics System (EXCELS). The Space Ground Link Subsystem (SGLS) was installed at three tracking stations and successfully supported the first satellite flown with this new equipment in October 1968. Installation of SGLS is continuing at the remainder of the tracking stations. The new Guam station is nearing completion and will become operational in early 1969. This modernization will provide a flexible, responsive satellite control network for existing and future DOD space programs.

Space Detection and Tracking—Air Force SPACETRACK and Navy SPASUR form the North American Air Defense Command's Space Detection and Tracking System (SPADATS). A new AN/FPS–85 phased array radar became operational in 1968. Located at Eglin Air Force Base, Fla., it will significantly improve the SPADATS capability to detect, track, identify and catalog all man-made objects in space.

Aeronautics Development Activity

C–5A Heavy Logistics Transport Aircraft—The C–5A, the world's largest military cargo aircraft, made its first flight and commenced Category I testing on schedule, in June 1968. Since that time three aircraft have flown 31 flights, for a total flying time of approximately 88 hours. Delivery dates on the next three aircraft have slipped slightly, but deliveries are expected to be back on schedule in May 1969. The C–5 engine (TF–39) has completed the 150-hour endurance test of the Formal Qualification Test (FQT). It is estimated that the FQT will be completed in May 1969.

F–111 Aircraft—The F–111A program has been in the process of transition from development to in-fleet status during the past year. Nearly 90 aircraft have been delivered to the Tactical Air Command. The Contractor's Category I test effort at Ft. Worth, Tex., Eglin AFB, Fla., and Edwards AFB, Calif., is continuing in those areas which normally proceed throughout production delivery. The Air Force Category II program at Edwards AFB also continues. The bulk of the continuing work is in the areas of weapons clearances, static and fatigue testing and full-flight envelope clearance.

The F–111D model which incorporates the advanced avionics package is, of course, still in the development stage, with first deliveries not scheduled until the latter part of 1969. The emphasis is almost completely on the avionics system, since development and testing of the aircraft itself has been largely accomplished in the F–111A program.

The success of the accelerated service test program which was initiated in June 1967 at Nellis AFB, Nev., resulted in a decision to deploy six F–111A's to SEA for a 6-month operational evaluation. This deployment took place on March 15, 1968, with the first stop at Guam, 5,770 nautical miles from Nellis. The unit landed at Takhli on March 17 and flew its initial combat mission 8 days later. The combat missions flown demonstrated a high capability for penetration and promise bombing accuracies during night and inclement weather unequalled by our other tactical systems.

Although the F–111 losses in 1968 were highly publicized and were the cause of concerted investigative efforts by the Air Force, it should be noted that the safety record of the F–111 exceeds other century-series aircraft at an equivalent point in time and is equalled only by the F–4.

The fatigue test program has revealed the need for a modification to the wing carry-through structure. This modification will be installed in retrofit for aircraft already assembled in production or in-fleet.

Delivery of the first F–111C aircraft to the Australians took place in September 1968. Delivery of the remaining aircraft will be made after modification of the wing carry-through structure.

On August 31, 1968, the first strategic bomber version of the F–111 was delivered to the Air Force. Designated the FB–111A, the aircraft was accepted and flown to Edwards AFB, where scheduled flight test will be completed. Later, bombers will be delivered to Carswell AFB, Tex., for build-up of the Combat Crew Training Wing.

Tactical Air Command is in the process of equipping the tactical wing at Nellis AFB. Crews are also flying